Machinery and Equipment Safety

Overview

Introduction

Industrial area supervisors have additional concerns compared to the supervisors in administrative environments. This module describes the various hazards of mechanical motion and presents some techniques for protecting workers from these hazards. Concerns include the following:

- Machine guarding
- Hand tools
- Power tools
- Lockout/Tagout Program

Machine Hazards

Introduction

Crushed hands and arms, severed fingers, blindness—the list of possible machinery-related injuries is as long as it is horrifying. There seem to be as many hazards created by moving machine parts, as there are types of machines. Safeguards are essential for protecting workers from needless and preventable injuries.

General rule of thumb

A good rule to remember is: Any machine part, function, or process which may cause injury must be safeguarded.

When the operation of a machine or accidental contact with it can injure the operator or others in the vicinity, the hazards must be either controlled or eliminated.

Where mechanical hazards occur

There are three basic areas of dangerous moving parts requiring safeguarding:

- The point of operation—that point where work is performed on the material, such as cutting, shaping, boring, or forming of stock.

- Power transmission apparatus—all components of the mechanical system which transmit energy to the part of the machine performing the work. These components include flywheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, cranks, and gears.

- Other moving parts—all parts of the machine which move while the machine is working. These can include reciprocating, rotating, and transverse moving parts, as well as feed mechanisms and auxiliary parts of the machine.

Moving machinery can grab more than your attention.

Machine Hazards, Continued

Hazardous mechanical motions and actions

A wide variety of mechanical motions and actions may present hazards to the worker. These can include the movement of rotating members, reciprocating arms, moving belts, meshing gears, cutting teeth, and any parts that impact or shear. These different types of hazardous mechanical motions and actions are basic in varying combinations to nearly all machines, and recognizing them is the first step toward protecting workers from the danger they present.

The basic types of hazardous mechanical motions and actions are shown in the table below:

Motions	Actions
• rotating • reciprocating • transversing	• cutting • punching • shearing • bending

Machine Controls

Requirements for safeguards

What must a safeguard do to protect workers against mechanical hazards? Safeguards must meet these minimum general requirements:

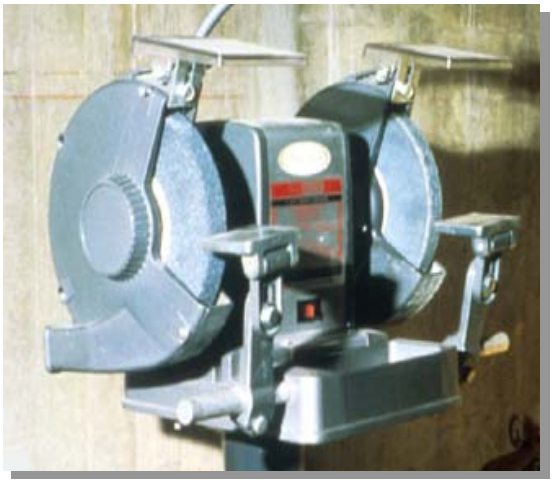
- Prevent contact: The safeguard must prevent hands, arms, and any other part of a worker's body from making contact with dangerous moving parts.
- Secure: Workers should not be able to easily remove or tamper with the safeguard, because a safeguard that can easily be made ineffective is no safeguard at all.
- Protect from falling objects: The safeguard should ensure that no objects could fall into moving parts. A small tool, which is dropped into a cycling machine, could easily become a projectile that could strike and injure someone.
- Create no new hazards: A safeguard defeats its own purpose if it creates a hazard of its own such as a shear point, a jagged edge, or an unfinished surface which can cause a laceration.
- Create no interference: Any safeguard, which impedes a worker from performing the job quickly and comfortably, might soon be overridden or disregarded.
- Allow safe lubrication: If possible, one should be able to lubricate the machine without removing the safeguards.

Methods of machine safeguarding

There are many ways to safeguard machines. The type of operation, the size or shape of stock, the method of handling, the physical layout of the work area, the type of material, and production requirements or limitations will help to determine the appropriate safeguarding method for the individual machine. As a general rule, fixed guards that enclose the danger areas best protect power transmission apparatus.

We can group safeguards under five general classifications.

- Guards
- Devices
- Location/distance
- Potential feeding and ejection methods to improve safety for the operator
- Miscellaneous aids



Machine Controls, Continued

Guards

Guards are barriers that prevent access to danger areas. There are four general types of guards:

- Fixed: As its name implies, a fixed guard is a permanent part of the machine. It is not dependent upon moving parts to perform its intended function.
- Interlocked: When this type of guard is opened or removed, the tripping mechanism and/or power automatically shuts off or disengages, and the machine cannot cycle or be started until the guard is back in place.
- Adjustable: Adjustable guards are useful because they allow flexibility in accommodating various sizes of stock.
- Self-Adjusting: The movement of the stock determines the openings of these barriers.

Devices

A safety device may perform one of several functions. It may

- stop the machine if a hand or any part of the body is inadvertently placed in the danger area
- restrain or withdraw the operator's hands from the danger area during operation
- require the operator to use both hands on machine controls, thus keeping both hands and body out of danger, or
- provide a barrier that is synchronized with the operating cycle of the machine in order to prevent entry to the danger area during the hazardous part of the cycle.

Safeguarding by location/distance

The dangerous moving part of a machine must be so positioned that those areas are not accessible or do not present a hazard to a worker during the normal operation of the machine. This may be accomplished by locating a machine so that the hazardous parts of the machine are located away from operator workstations or other areas where employees walk or work.

Feeding and ejection methods to improve operator safety

Many feeding and ejection methods do not require the operator to place his or her hands in the danger area. In some cases, no operator involvement is necessary after the machine is set up. In other situations, operators can manually feed the stock with the assistance of a feeding mechanism.

Hand Tools

Introduction

Tools are such a common part of our lives that it is difficult to remember that they may pose hazards. An incident can occur before steps are taken to identify and avoid tool-related hazards.

Employees who use hand and power tools and are exposed to the hazards of

- falling, flying, abrasive, splashing objects, or
- harmful dusts, fumes, mists, vapors, or gases.

What are hand tools?

Hand tools are tools that are powered manually. Hand tools include anything from axes to wrenches. The greatest hazards posed by hand tools result from misuse and improper maintenance.

Hazards

Examples of misuse or improper maintenance include the following:

- If a chisel is used as a screwdriver, the tip of the chisel may break and fly off, hitting the user or other employees.
- If a wooden handle on a tool, such as a hammer or an axe is loose, splintered, or cracked, the head of the tool may fly off and strike the user or other employees.
- If the jaws of a wrench are sprung, the wrench might slip.
- If impact tools, such as chisels, or wedges have mushroomed heads, the heads might shatter on impact, sending sharp fragments flying toward the user or other employees.

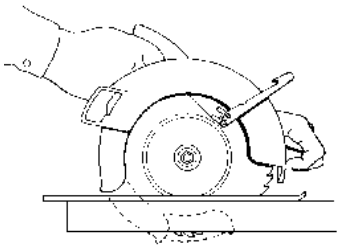
Controls

To prevent hazards associated with the use of hand tools, workers should observe the following general precautions:

- When using saw blades, knives, or other tools, employees should direct the tools away from aisle areas and away from other employees working in close proximity.
- Knives and scissors must be sharp; dull tools can cause more hazards than sharp ones.
- Cracked saw blades must be removed from service.
- Wrenches must not be used when jaws are sprung to the point that slippage occurs.
- Impact tools such as drift pins, wedges, and chisels, must be kept free of mushroomed heads.
- Spark-resistant tools should be used where flammable gases, highly volatile liquids, and other explosive substances are stored or used.

Power Tools

Introduction



The types of power tools are determined by their power source: electric, pneumatic, liquid fuel, hydraulic, and powder-actuated. Power tools must be fitted with guards and safety switches. They are extremely hazardous when used improperly!

Safety precautions when using power tools

To prevent hazards associated with the use of power tools, workers should observe the following safety precautions:

- Never carry a tool by the cord or hose.
- Never yank the cord or the hose to disconnect it from the receptacle.
- Keep cords and hoses away from heat, oil, and sharp edges.
- Disconnect tools when not using them, before servicing and cleaning them, and when changing accessories such as blades, bits, and cutters.
- Keep all people not involved with the work at a safe distance from the work area.
- Secure work with clamps or a vise, freeing both hands to operate the tool.
- Avoid accidental starting. Do not hold fingers on the switch button while carrying a plugged-in tool.
- Maintain tools with care; keep them sharp and clean for best performance.
- Follow instructions in the user's manual for lubricating and changing accessories.
- Be sure to keep good footing and maintain good balance when operating power tools.
- Wear proper apparel for the task. Loose clothing, ties, or jewelry can become caught in moving parts.
- Remove all damaged portable electric tools from use and tag them: "Do Not Use."

Power Tools, Continued

Guards

The exposed moving parts of power tools need to be safeguarded. Belts, gears, shafts, pulleys, drums, flywheels, chains, or other reciprocating, rotating, or moving parts of equipment must be guarded. Machine guards, as appropriate, must be provided to protect the operator and others from the following:

- Point of operation
- In-running nip points
- Rotating parts
- Flying chips and sparks

Safety guards must never be removed when a tool is being used. Portable circular saws having a blade greater than 2 inches (5.08 centimeters) in diameter must be equipped at all times with guards. An upper guard must cover the entire blade of the saw. A retractable lower guard must cover the teeth of the saw, except where it makes contact with the work material. The lower guard must automatically return to the covering position when the tool is withdrawn from the work material.

Constant-pressure switch or control

The following hand-held power tools must be equipped with a constant-pressure switch or control:

- Drills
- Fastener drivers
- Horizontal, vertical, and angle grinders with wheels more than 2 inches in diameter
- Disc sanders with discs greater than 2 inches
- Reciprocating saws
- Jigsaws with blade shanks greater than 1/4-inch wide
- Other similar tools

Note: These tools also may be equipped with a "lock-on" control, if it allows the worker to shut off the control in a single motion using the same finger or fingers.

Positive "on-off" control switch

The following hand-held power tools must be equipped with a positive "on-off" control switch, a constant pressure switch, or a "lock-on" control:

- Disc sanders with discs 2 inches (5.08 centimeters) or less in diameter
- Grinders with wheels 2 inches (5.08 centimeters) or less in diameter
- Routers
- Planers
- Other similar tools

Note: Other hand-held power tools, such as circular saws having a blade diameter greater than 2 inches, chain saws, and percussion tools with no means of holding accessories securely, must be equipped with a constant-pressure switch that will shut off the power when the pressure is released.

Electric Tools

Introduction

Employees using electric tools must be aware of several dangers. Among the most serious hazards are electrical burns and shocks. Shocks, which can lead to injuries or even heart failure, and burns are among the major hazards associated with electric-powered tools. To protect the user from shock and burns, electric tools must have a three-wire cord with ground and be

- plugged into a grounded receptacle
- double insulated, or
- powered by a low-voltage isolation transformer.

General safety practices when using electric tools

The following general practices should be followed when using electric tools:

- Operate electric tools within their design limitations.
- Use gloves and appropriate safety footwear when using electric tools.
- Store electric tools in a dry place when not in use.
- Do not use electric tools in damp or wet locations unless they are approved for that purpose.
- Keep work areas well lighted when operating electric tools.
- Ensure that cords from electric tools do not present a tripping hazard.

Portable abrasive wheel tools

Portable abrasive grinding, cutting, polishing, and wire buffing wheels create special safety problems because they may throw off flying fragments. Abrasive wheel tools must be equipped with guards that

- cover the spindle end, nut, and flange projections
- maintain proper alignment with the wheel, and
- do not exceed the strength of the fastenings.

Abrasive wheel testing

Before an abrasive wheel is mounted, it must be inspected closely for damage and should be sound- or ring-tested to ensure that it is free from cracks or defects. To test, wheels should be tapped gently with a light, non-metallic instrument. If the wheels sound cracked or dead, they must not be used because they could fly apart in operation. A stable and undamaged wheel when tapped will give a clear metallic tone or “ring.”

Preventing cracking

To prevent an abrasive wheel from cracking, it must fit freely on the spindle. The spindle nut must be tightened enough to hold the wheel in place without distorting the flange. Always follow the manufacturer’s recommendations. Take care to ensure that the spindle speed of the machine will not exceed the maximum operating speed marked on the wheel.

An abrasive wheel may disintegrate or explode during startup. Allow the tool to come up to operating speed prior to grinding or cutting. The employee should never stand directly in front of the wheel as it accelerates to full operating speed . Portable grinding tools need to be equipped with safety guards to protect workers not only from the moving wheel surface, but also from flying fragments in case of wheel breakage.

Electric Tools, Continued

Tips for using a powered grinder

Follow these tips when using a powered grinder:

- Always use eye or face protection.
- Turn off the power when not in use.
- Never clamp a hand-held grinder in a vise.

Checklist for abrasive wheel grinders

Appendix B provides a checklist that can be used to ensure grinders meet OSHA standards.

Lockout/Tagout (LOTO) Program

Introduction

The OSHA standard for The Control of Hazardous Energy (Lockout/Tagout) (LOTO), Title 29 CFR Part 1910.147, addresses the practices and procedures necessary to disable machinery or equipment, thereby preventing the release of hazardous energy while employees perform servicing and maintenance activities. The standard outlines measures for controlling hazardous energies—electrical, mechanical, hydraulic, pneumatic, chemical, thermal, and other energy sources.

It also requires an employer to establish a program consisting of energy control procedures, employee training, periodic inspections, and recordkeeping.

Why lockout/tagout?

An employee needs to control energy before working in situations involving repair and replacement or renovation work, and modifications or other adjustments to power equipment. Not controlling the energy to equipment being worked on puts the employee in a dangerous situation.

Definitions

Lockout is the process of blocking the flow of energy from a power source to a piece of equipment, and keeping it blocked out. LOCKOUT is accomplished by installing a lockout device at the power source so that equipment powered by that source cannot be operated.

A lockout device is a lock block or chain that keeps a switch, valve, or level in the off position. Locks are provided by the employer and can be used only for lockout purposes. They should never be used to lock toolboxes, storage sheds, or other devices.

Tagout is the placing of a tag on the power source. The tag acts as a warning not to restore energy. The tag is not a physical restraint. Tags must clearly state: **DO NOT OPERATE** or the like, and must be applied by hand.

Note: Both locks and tags must be strong enough to prevent unauthorized removal and to withstand various environmental conditions.

Authorized employees physically lock or tag out equipment for servicing or maintenance. These may or may not be the people who normally operate the equipment.

Affected employees are those whose job requires them to operate equipment subject to lockout/tagout, or those employees who work in areas where lockout/tagout is used. Employers should inform employees if they are affected employees.

Lockout/Tagout (LOTO) Program, Continued

Program elements

These are the key elements of a LOTO program:

- A description of the responsibilities of some key personnel, and safety and health officials responsible for the LOTO program, and identification of who will review the program
- A description and list of equipment to be tagged out
- A list of employees subject to the requirements of the program
- What training is required for those employees subject to the program

Written plan

The OSHA standard requires a written plan that clearly and specifically explains:

- The intended use of the LOTO procedures
- How to shut down, isolate, block, and secure equipment to control hazardous energy
- The sequence to place, remove, and transfer lockout or tagout devices and who is responsible for them
- Steps to test a machine or equipment to make sure it is locked or tagged out

Lockout/tagout procedures

Procedures for lockout/tagout describe how to

- perform a shutdown
- isolate equipment
- apply and remove lockout devices, and
- safely release stored energy to ensure that a zero energy state exists.

Training

OSHA requires the following training:

- All **authorized employees** must be trained in the recognition of hazardous energy sources, hazardous energy sources in use at the facility, and how to perform the lockout/tagout procedure.
- All **affected employees** must be trained in the purpose and use of lockout/tagout.
- All **other employees** must be instructed as to the purpose of the plan, but not in its actual use.

Retraining must be done when there are changes in equipment, job assignment, or procedures; when an audit shows deficiencies with the procedures; and when the employer feels the procedures should be reviewed.